OPERATIONAL REQUIREMENTS DOCUMENT

FOR THE

UNMANNED AERIAL VEHICLE (UAV) TACTICAL CONTROL SYSTEM (TCS)

1. <u>General Description of Operational Capability</u>

   a. <u>Mission Area</u>. The requirement relates to the Office for the Under Secretary of Defense (Acquisition, Technology, and Logistics) Mission Areas 212 (Indirect Fire Support), 217 (Land Warfare Surveillance and Reconnaissance), 223 (Close Air Support and Interdiction), 227 (Air Warfare Surveillance and Reconnaissance), 232 (Amphibious, Strike, and Antisurface Warfare), 237 (Naval Warfare Surveillance and Reconnaissance), 322 (Tactical Intelligence and Related Activities (TIARA) for Tactical Land Warfare), 345 (Tactical Communications), 370 (Electronic Combat) and 373 (Tactical Surveillance, Reconnaissance, and Target Acquisition).

   b. <u>System Description</u>. The Tactical Control System (TCS) is the software and software-related hardware designed to support command and control of the U.S. Army (USA) Tactical Unmanned Aerial Vehicle (TUAV), the U.S. Navy (USN) Vertical Takeoff and Landing Tactical UAV (VTUAV), the U.S. Air Force (USAF) RQ-1 Predator Medium Altitude Endurance (MAE) UAV, and future Tactical and MAE UAVs. TCS will support interfaces with identified Command, Control, Communications, Computers, and Intelligence (C^4I) systems. (Threshold). TCS will support direct payload data receipt from High Altitude Endurance (HAE) UAVs (Objective). TCS will be hosted on the Service-provided, specified Defense Information Infrastructure/Common Operating Environment (DII/COE) compliant Ground Control Station (GCS)[1]. Although developed as a total package, TCS will have the capability to be configured and scaled to meet the user's requirements.

   (1) <u>Software</u>. The deliverable product of the TCS Program is software. The software will provide the UAV operator the necessary tools for computer related communications, mission tasking, mission planning, mission execution, data processing and data dissemination. The software will provide a high resolution, computer generated, graphical user interface (GUI) that will enhance joint use and interoperability of different types of UAVs and UAV payloads. TCS software developed will be DII-COE/Joint Technical Architecture (JTA) compliant, non-proprietary (to the maximum extent possible), and the architectural standard for all future Tactical and MAE UAVs. TCS will support long range communications from one TCS compliant GCS to another, data storage expansion, access to other computers to share in processing capability and multiple external peripherals. TCS shall use Department of Defense (DoD) standard command and control GUI. TCS will employ an open architecture capable of being hosted on computers that are typically supported by the using Service.

   (2) <u>Service Hardware</u>. Procurement of hardware to host TCS is the responsibility of the respective Services. TCS will be designed to operate on Service specific hardware and support the scalable needs of the Services requirements. The TCS Program is not required to provide the communications nets or hardware required to interface with different UAV systems.

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[1] This requirement does not apply to TCS integration into the legacy USAF Predator GCS.

(a) USA/U.S. Marine Corps (USMC). TCS will be integral to the USA TUAV GCS and the USMC VTUAV GCS.

(b) USN. TCS will be integral to the USN VTUAV GCS and provide varying levels of interaction across the fleet with Tactical, MAE and HAE UAVs as required. TCS will be the control system for future ship-based UAVs and UAV operations. For USN ships without UAVs, a TCS equipped workstation will be integrated with the ship to provide the required connectivity to UAV operations.

(c) USAF. The USAF RQ-1 Predator GCS will provide sensor and payload control, flight control and launch and recovery capability for the Predator Air Vehicle (AV). TCS will be incorporated into the USAF RQ-1 Predator GCS to provide TCS direct data receipt and data dissemination to the required TCS C^{4}I architectures (Threshold). TCS software must be designed to be hosted on the Predator GCS existing and fielded hardware.

  c. Operational Concept. TCS will be employed as part of the UAV system it supports.

   (1) Levels of Interaction. TCS software will support five levels of UAV interaction.

      (a) Level One is the indirect receipt and direct retransmission of imagery and/or data.

      (b) Level Two is the receipt of imagery and/or data directly from the UAV and the functionality of previous level.

      (c) Level Three is the control of the UAV payload and the functionality of previous levels.

      (d) Level Four is control of the UAV, less takeoff and landing, and the functionality of previous levels.

      (e) Level Five is the full functionality and control of the UAV from takeoff to landing.

   (2) Scaled and Modular Design. TCS software must be capable of being hosted on a variety of computers, including legacy USAF RQ-1 Predator systems. To meet Joint Warfighting needs, the core software will be generically written to support Level Five interaction for both TUAV and VTUAV and Level Four for the Predator MAE UAV, and will establish the architecture for future Tactical and MAE UAVs. Since not all recipients of UAV information require all levels of TCS interaction, the software, and software-related hardware, will be developed so that it is scaleable to meet both Service requirements and joint warfighting needs. TCS will prevent users from entering levels of interaction for which they are not authorized through software and hardware configuration and/or operational doctrine.

   (3) Joint Operations Concept. TCS will enable joint warfighter interoperability with the family of Tactical and MAE UAV systems. TCS will allow the joint warfighter to plan varying levels of interaction with available UAVs to support intelligence, surveillance and reconnaissance (ISR) tasks in real time or near real time (NRT). TCS also provides joint warfighting flexibility by enabling forces directly engaged with the enemy to be supported by available UAVs that can meet time critical targeting and battle damage assessment needs.

d. Support Concept. Each Service will support TCS as part of their organic UAV system. TCS equipped workstations will be supported IAW host system Service standard operating procedures.

e. Mission Need Statement (MNS). The Chairman of the Joint Requirements Oversight Council (JROC) signed the MNS for a Close Range Reconnaissance, Surveillance, and Target Acquisition (RSTA) Capability[2] and a MNS for a Long Endurance Reconnaissance, Surveillance, and Target Acquisition Capability on 5 January 1990[3].   Both MNSs state the need to interface with current and planned selected standard DoD C3I systems, architectures and protocols. There are no non-materiel alternative solutions that will establish a standard software architecture for UAVs.

2. Threat

a. Validated Studies. Detailed information on threats to the UAV TCS mission:

(1) National Air Intelligence Center (NAIC) documents:

(a) NAIC-1574-0730-97, Air Combat Threat Environment Description, January 1997; NAIC-1574-0210-97, Information Warfare Threats to Automated Information Systems, April 1997.

(b) NAIC –1574-0731-98, Electronic Combat Threat Environment Description, January 1998.

(2) Defense Intelligence Agency (DIA) documents:

(a) Marine Corps Intelligence Activity – Expeditionary Warfare Threat Environment Projections Volume 1: Command, Control, Communications, Computers, and Intelligence (C^4I), C^4I Support, and Electronic Warfare, MCIA-1527-001-98, May 1998.

(b) National Air Intelligence Agency – Electronic Combat Threat Environment Description, NAIC-1574-0731-98, Jan 1998; National Air Intelligence Agency – Information Warfare Threat To Automated Information Systems Threat Environment Description, NAIC-1574-0210-97, Apr 1997.

b. Threats to be Encountered. TCS is unlikely to be directly targeted. It will face the same threats as any other system deployed with operational military units. These threats include electronic warfare, information warfare, and physical destruction. When the UAV GCS is transmitting, the major electronic threat includes direction finding and jamming. Adversaries could home in on the UAV GCS signal to locate the sources of its electronic emissions. Additionally, the electronic warfare threat includes systems that could jam the UAV GCS datalinks to and from the AV, possibly disrupting control of the AV and/or its payload. The information warfare threat consists of corruption of the computer code. This malicious code, (e.g. viruses, logic bombs and trap doors) is engineered to cause a computer to act in a manner other

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[2] The Close Range UAV mission need will be met through the USA TUAV and USN/USMC VTUAV ORDs.
[3] Joint Requirements Oversight Council Memorandum 003-90.

than that intended by its users. The final threat to TCS comes from physical destruction. Ground equipment is vulnerable to collateral damage depending on the equipments' proximity to targeted assets. This physical damage/destruction may be from aircraft weaponry, artillery, surface-to-surface and air-to-surface weapons, ground forces, terrorism, sabotage, and nuclear, biological and chemical (NBC) weapons.

   c. Information Operations (IO). IO involves actions taken to gain information superiority by affecting adversary information and information systems, while defending one's own information and information systems. IO applies across all phases of an operation, throughout the range of military operations, and at every level of war. IO includes, but is not limited to, electronic warfare, physical destruction, operational security, deception, and information attack. As a mission of UAVs is to provide information, the system may be a lucrative target of IO.

3. Shortcomings of Existing Systems

   a. Current. UAV systems operate using proprietary AV C3I interface software and some unique hardware. Current UAV systems require separate unique interfaces for interoperability with existing C3I systems.

   b. Projected. TCS will provide a non-proprietary software package capable of supporting multiple levels of command and control functions to a family of UAVs based on user requirement. The family of UAVs includes: TUAV, VTUAV, RQ-1 Predator MAE and future tactical and MAE UAVs. Additionally, TCS will enable interoperability between the UAV system and the C4I systems delineated in this ORD.

4. Capabilities Required

   a. System Performance

    (1) General. The TCS software, operating within USA, USMC and USN GCS's will support Level Five interaction with their organic UAVs. The USAF RQ-1 Predator GCS will incorporate TCS Level Two data/information interoperability with the Predator AV and provide data dissemination to the TCS required C4I nodes (Threshold) (**Key Performance Parameter**). The TCS software will support, up to and including, Level Five interoperability with future TUAVs and, up to and including, Level Four with USAF RQ-1 Predator MAE and Level Two with the HAE. (Objective). Each Service will determine its respective scaleable requirements for GCS hardware required to host TCS. TCS will:

     (a) Be an open software architecture that can support current and future Tactical and MAE UAVs. (Threshold). It will support different payload packages in addition to imagery, such as signals intelligence (SIGINT) collection and dissemination, or a laser designator (Objective).

     (b) Have software based on the DII/COE per Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (ASD(C3I)) JTA (Threshold).

     (c) Support operator controls and displays (Threshold).

     (d) Support monitor(s) IAW Service requirements (Threshold).

(e) Support a commercial or DoD standard GUI (Threshold).

(f) Support peripheral ports to drive external devices. As a minimum, TCS should support all requirements inherent in the appropriate supported UAV ORD (Threshold).

(g) Support integration of software modules for controlling future payloads, payload capabilities (e.g., autosearch and automatic target tracking) and future Tactical and MAE UAVs (Threshold).

(h) Support simultaneous flight and payload control of at least two AVs, line of sight (LOS) (Threshold)**(KPP)**. Support simultaneous flight and payload control of at least two AVs, beyond line of sight (BLOS)(Objective). Simultaneous flight and payload control is the ability to operate at least two AVs at the same time, over an equal number of active data links from the same TCS configuration, such as a High Mobility Multipurpose Wheeled Vehicle (HMMWV) mounted shelter.

(i) TCS will be interoperable with different types of UAVs and UAV payloads across the five levels of interaction (Threshold)**(KPP),** and at least two different platforms and payloads simultaneously (Objective).

(j) Meet the operational and physical security requirements of the system it supports (Threshold).

(k) Support other systems with TCS capabilities in addition to the C^4I functions listed in paragraph 5.e.(2) (Objective).

(2) Mission Planning. TCS mission planner will be Joint Mission Planning System (JMPS) compliant (excludes USAF RQ-1 Predator GCS) and will:

(a) Be capable of importing National Imagery and Mapping Agency (NIMA) Digital Terrain Elevation Data (DTED), Digital Feature Analysis Data (DFAD), Arc Digitized Raster Graphic (ADRG) and scanned hard copy maps, be capable of selecting and cross referencing between various datums and map reference systems (Threshold). The system will be capable of importing map information via UAV operator procedure (Threshold), be capable of incorporating vector format and Compressed ADRG (CADRG) maps and support a three dimensional mission rehearsal capability (Objective).

(b) Include basic flight planning tools. As a minimum these tools will include:

(1) Weight and balance takeoff data calculations.

(2) Fuel calculations.

(3) Terrain avoidance warning and minimum reception altitude calculations for LOS flights.

(4) Payload search area information such as visual acuity range due to atmospheric conditions, diurnal transition periods for thermal imagery, lunar and solar terrain shadowing and basic flight weather conditions (temperature, humidity, turbulence, winds, etc.)(Objective).

(c) Provide point-and-click route and sensor planning (Threshold).

(d) Program AVs with mission planning data prior to launch (Threshold).

(e) Utilize joint standard tools for importing or creating overlays for fire support coordination measures, airspace control measures and threat (Objective).

(f) Include survivability planning that will:

(1) Provide override of payload and AV automated/preprogrammed inputs (Threshold).

(2) Provide a method of displaying Service-provided AV signature (radar, visual, thermal, and acoustic) versus threat, before and during flight (Objective).

(3) Display overlays or icons of known threat systems, the threat engagement envelopes and associated radar terrain masking for those threats for route planning (Threshold). Be capable of dynamically updating the threat picture throughout the mission (Objective).

(g) Be capable of storing mission plans and exporting them to other TCS-compliant GCSs (Threshold) and exporting them to force level mission planning systems (Objective).

(h) Support upload to, and receipt of, mission plans from Service-specific mission planning systems (Threshold).

(i) Be capable of changing the mission plan while the AV is airborne (Threshold).

(3) <u>Launch and Recovery</u>. TCS will support AV launch and recovery operations as required by the Service UAVs . The system will provide sufficient cues to allow the UAV operator to safely take off, land, and navigate under Instrument Flight Rules (Threshold). TCS will support an automatic launch and recovery system for UAVs with that capability (Threshold).

(4) <u>Mission Execution</u>. During mission execution, TCS will support (excluding legacy USAF Predator systems):

(a) The display of the location and systems status of the AVs and the system status of the GCS and datalinks (Threshold).

(b) The display of the search footprint of the payload on the moving map (Threshold).

(c) Dynamic mission and sensor retasking during operational mission execution (Threshold).

(d) Receipt, processing, formatting, storage and retrieval and dissemination of flight, payload data, and weather data (if available from the AV). This includes viewing the payload

imagery on a display (to potentially include limited exploitation of imagery by appropriately trained imagery analysts IAW CINC and Service CONOPS and Service-specific analyst training programs)(Threshold).

(e) The receipt and control of payloads on an AV that is being controlled from another TCS-compliant GCS (Threshold).

(f) Passing AV control from one TCS-compliant GCS to any other TCS-compliant GCS (Threshold).

(g) Providing a caution/warning to the operator when the UAV system has identified a malfunction (Threshold).

(h) Antenna switching when the AV is masked by obstructions to ensure uninterrupted connectivity (Threshold).

(i) Output of real-time video for NRT dissemination (Threshold).

(j) Automatic fire adjustment calculations for indirect fire weapons and Close Air Support (CAS)(Threshold).

(k) Providing communications link status (Objective).

(5) Imagery Intelligence Processing. TCS shall provide the capability to view the UAV imagery data (to potentially include limited exploitation of imagery by appropriately trained imagery analysts IAW CINC and Service CONOPS and Service-specific analyst training programs). TCS equipped imagery processing work station will have the capability to support the following functions:

(a) Video/Synthetic Aperture Radar (SAR) frame grabbing, image annotation, image archiving, video/SAR recording/playback and data dissemination (Threshold). Full motion imagery and mosaic (Objective).

(b) The standards developed for compliance with Common Imagery Ground/Surface Station (CIGSS), United States Imagery Standards (USIS), Global Command and Control System (GCCS) and Video Imagery Standards Profile (VISP)(Threshold).

(c) The capability to display NRT imagery with annotation to include date/time group, target location when in the center field of view, north seeking arrow (selectable north references), AV position and heading (Threshold).

(d) Built-in word processing and text capability including the ability to overlay textual information on imagery (Threshold).

(e) Ports for outputting data and imagery to a hard-copy printer, recording media and data servers in National Imagery Transmission Format (NITF) and Joint Photographic Experts Group (JPEG) formats (Threshold).

(f) A means of inputting data from external data storage systems (Threshold).

(g) The capability to distribute NRT video to commercially available television monitors and videocassette recorders via external ports (Threshold).

(h) Image enhancement (contrast, brightness, edge enhancement, sharpness and zoom capability)(Threshold).

(i) The capability to select/deselect cross hairs (or other similar icon) to identify center of target (Threshold). The capability to select/deselect all graphical information item-by-item (Objective).

(j) The capability to display target symbols (Threshold) in sizes selected by the operator (Objective).

(k) The capability to interoperate with a server to receive, extract and push intelligence data (Threshold).

(6) Communications Subsystems

(a) Data Links

(1) TCS must support a simultaneous uplink and downlink capability (Threshold).

(2) TCS will support interfaces with the respective Service organic UAV data links as necessary to execute control of the AV and payload (Threshold).

(3) TCS will simultaneously support LOS and BLOS data links (Threshold).

(b) Other Communications. TCS will be interoperable with the C^4I systems listed in paragraph 5e(2) of this ORD per ASD (C3I) JTA standards (Threshold) **(KPP)**[4]. TCS will be interoperable with the additional C^4I systems listed in paragraph 5e(3) of this ORD (Objective). TCS will provide the following communications support[5]:

(1) Interfacing with networks (Threshold).

(2) The use of cable, i.e. Closed Circuit Television (CCTV), to deliver live video imagery in multiple locations (Threshold).

(3) The use of Service-specific ground or airborne Ultra High Frequency (UHF), Very High Frequency (VHF), and UHF/VHF and High Frequency (HF) radios for digital message transmission, while using the same radios for record traffic (Threshold).

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[4] Not all C4I systems are required at IOC. Joint Service priority will be promulgated by separate correspondence.
[5] Refer to the TUAV, VTUAV and MAE ORDs for communication requirements that are not connected to the TCS.

b. Logistics and Readiness

(1) Operational Availability. TCS must meet the mission capability criteria and system redundancy specified by UAV system ORDS.

(2) Maintenance. TCS will be maintained IAW the UAV ORD for that Service and the level of repair analysis for the hardware chosen.

(3) Surge and Mobilization Objectives and Capabilities. TCS must meet the deployment criteria for the organic unit to which it is assigned.

c. Other System Characteristics

(1) Natural Environmental Factors. TCS software and related hardware must meet the environmental requirements of the associated UAV system.

(2) Spectrum Certification. TCS will comply with the applicable DoD, national and international spectrum management policies and regulations. The system shall obtain spectrum certification IAW DoD Directive 4650.1.

(3) Electromagnetic Environmental Effects. TCS will be mutually compatible with itself and other systems in the operational electromagnetic environment. The operational performance of TCS will not be degraded due to electromagnetic environmental effects.

5. Program Support. The TCS ORD is a companion to the existing USA TUAV, USN/USMC VTUAV and USAF RQ-1 Predator MAE UAV ORDs. Joint Potential Designators are USA (joint), USMC (joint), USN (joint) and USAF (joint). There is allied interest in this program.

a. Maintenance Planning

(1) A TCS support and fielding package will be developed and available for developmental testing. TCS operational testing will be conducted with its Service-specific UAV system.

(2) TCS software will be maintained in accordance with (IAW) the TCS Computer Resources Life Cycle Management Plan (CRLCMP). The CRLCMP will be tailored to establish the plan for managing, acquiring, developing, testing and supporting TCS software and/or software related hardware throughout the Service-specific UAV system's life.

b. Support Equipment

(1) Support Concept. Support for TCS will be IAW the Services' GCS support plan and the Joint Acquisition Logistical Support Plan (JALSP).

(2) Fault Detection/Location (FD/L). TCS shall support FD/L during initial system computer boot-up (Threshold). TCS shall support UAV system built-in test (BIT) as defined by UAV system ORDs (Objective).

c. Human System Integration

(1) Manpower Constraints. TCS manpower requirements shall not exceed the Services' guidelines for their respective UAV Program. Manpower to integrate and operate a TCS equipped workstation is a Service requirement.

(2) Training Assessment

(a) General. Training shall be balanced between institutional, New Equipment Training (NET), embedded training and unit training as required by the appropriate supported UAV ORD. Instructor and key personnel training will be required.

(b) NET. Receiving units will receive NET as the system is fielded.

(c) Institutional Training. TCS software shall support training as required for the institutional training base.

(d) Unit Training. Unit training will be conducted IAW Service requirements.

(e) Sustainment Training Devices. The system will provide, for both operator and maintainer, the capability for incorporation of embedded/add-on interactive training with self-paced instruction, duplicating AV flight performance characteristics, capabilities and limitations. TCS system will support training using simulation as required by UAV system ORDs.

(f) Operator/Technical Manuals. Both operator manuals and technical manuals will be verified and validated prior to initial operational test.

(3) System Safety and Health Hazard Assessment. System safety and health hazards, if any, will be identified and evaluated. Risk levels and a program to manage the probability and severity of hazards will also be developed.

d. Computer Resources and Hardware Performance[6]

(1) Software Application Development. TCS software will comply with National Institute for Standard Technology (NIST) Federal Information Processing Standard (FIPS) Publication 151-2 (POSIX.1) to ensure software application portability (Objective).

(2) Technical Data Package (TDP). The TCS program will develop a tailored TDP using MIL-STD-31000A as guidance. The TCS TDP elements will provide the information necessary to enable the procurement of a suite of hardware by the Service-specific UAV program such that the resulting physical system supports the architecture, interfaces and functional characteristics of TCS (Threshold).

(a) Hardware Performance Specifications (HWPS). As part of the TCS TDP, the TCS program will develop HWPS for use by the Service-specific UAV system program during TCS host hardware selection and procurement. The TCS HWPS will be based upon the System

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[6] This requirement does not apply to TCS integration into the legacy USAF Predator GCS.

Architecture (SA) and will identify the hardware technical performance factors required for optimal TCS software execution. MIL-STD-961 DoD Standard Practice for Defense Specifications and SD-15 Defense Standardization Program Performance Specification Guide will be used as guidance regarding performance specification content. The performance specifications will not identify specific hardware solutions, only hardware performance factors and architecture requirements that are necessary to support optimum TCS operation.

(b) <u>Minimum Memory Capacity</u>. For all processors required by the TCS architecture, the HWPS will identify the minimum amount of random access memory (RAM) required to execute TCS software, as well as the minimum hard disk storage capacity required to support TCS operation. This information will be provided to the Service-specific UAV program in order to support procurement of computing suites that satisfy that UAV program specific ORD requirements for reserve memory capacity.

(3) <u>TCS System Architecture (SA)</u>. TCS SA will be designed to ensure that the throughput (the measure of the amount of data transferred from one point in the system to another) as determined by computer central processing unit (CPU) utilization, interface bandwidth utilization, and software execution factors, provides a 50% reserve above that which is required for TCS operation (Threshold). The TCS SA should provide a 75% reserve above that which is required for TCS operation (Objective).

(4) TCS shall comply with the ASD(C3I) JTA. This includes, but is not limited to, the language, operating systems databases, architecture and interoperability (Threshold).

e. <u>Command, Control, Communications, and Intelligence (C3I)</u>

(1) TCS will support direct connectivity to standard DoD tactical (VHF, UHF, UHF/VHF and HF) radios to include the Enhanced Position Location Reporting System (EPLRS) (Objective), Mobile Subscriber Equipment, military and commercial satellite communications.

(2) <u>TCS/C4I Compliant Systems (Threshold)</u>(**KPP**). TCS shall be capable of entering DII-COE compliant C^4I systems, to include GCCS, that comply with the JTA. Network connectivity should include but not be limited to: radio data burst connectivity to Automatic Target Hand-off Systems (ATHS), Advanced Field Artillery Tactical Data Systems (AFATDS), and Army Deep Operations Coordination System (ADOCS); wire connectivity to the All Source Analysis System (ASAS); the Intelligence Analysis System (IAS); the Joint Surveillance Target Attack Radar System (JSTARS) Ground Station Module/Common Ground Station ((GSM/CGS); Closed Circuit Television (CCTV); Advanced Tomahawk Weapons Control Station (ATWCS); Joint Deployable Intelligence Support System (JDISS); TROJAN Special Purpose Integrated Remote Intelligence Terminal (SPIRIT) II; Joint Service Imagery Processing System (JSIPS); JSIPS-Navy and JSIPS Tactical Exploitation Group (TEG); JSIPS Tactical Exploitation System (TES); Service mission planners; Theater Battle Management Core System (TBMCS); Guardrail Common Sensor/Aerial Common Sensor (ACS) Integrated Processing Facility (IPF); Modernized Imagery Exploitation System (MIES); Enhanced Tactical Radar Correlator (ETRAC); Contingency Airborne Reconnaissance System (CARS); and Common Operational Modeling, Planning, and Simulation System.

(3) <u>TCS/C4I Compliant Systems (Objective)</u>. Improved Data Modem (IDM) and Tactical Air Control Party (TACP) Modernization Plan, computers and software as defined in USAF AC2AISRC ORD CAF 307-97-I/II/III; the Naval Fires Control System (NFCS); the Joint Mission Planning System (JMPS) and the future Distributed Common Ground Station (DCGS) environment; Integrated Meteorological System (IMETS) and other UAV-related C^4I systems such as Force XXI Battle Command Brigade and below (FBCB2); Forward Area Air Defense Command and Control (FAADC2) system; systems that facilitate mission planning such as Tactical Airspace Integration System (TAIS) and the Aviation Mission Planning System (AMPS); NAVY Integrated Tactical Environmental Subsystem (NITES); USMC Simulation System, Tactical Air Operations Module, Improved Direct Air Support Center (DASC) and Tactical Air Command Center (TACC); and Joint Special Operations Task Force (JSOTF) systems.

f. <u>Transportation and Basing</u>. Not applicable.

g. <u>Standardization, Interoperability, and Commonality</u>. The UAV TCS shall comply with applicable information technology standards contained in DoD Joint Technical Architecture (JTA).

(1) TCS is capable of exchanging a variety of standard data products with the previously stated joint/Service specific C4I systems. In order to achieve "sensor-to-shooter" systems interoperability, the exchanged products must comply with applicable commercial and military standards. The United States Message Text Formats (USMTFs) will comply with MIL-STD 6040, the Variable Message Format (VMF) messages will comply with Technical Interface Design Plan (TIPD) Reissue 3, the still imagery files will comply with National Imagery Transmission Formats (NITF) Version 2.0/2.1, and the full motion video will comply with the National Transmission Standards Committee (NTSC) standard. Service unique Message Text Formats (MTF) (i.e. ACCS, IEWCOMCAT, OTH Gold, etc.) will comply with the applicable standards of the specific service.

(2) TCS will adhere to DoD regulations and policy governing military standards for logistics; petroleum, oil, lubricants (POL); tools; test, measurement, and diagnostic equipment (TMDE); and other support items.

h. <u>Geospatial and Information Services Support</u>. TCS will require support from NIMA for standard format digitized map displays with elevation data that do not require transformation for compatibility. All systems requiring NIMA products or services must be United States Imagery and Geospatial Information System (USIGS) compliant.

i. <u>Environmental Support</u>. Environmental support will be the same as that required for the respective UAV System.

6. <u>Force Structure</u>

a. <u>USA</u>. Requires TCS software in the GCSs for the 44 TUAV systems to meet the requirements for active divisions, brigades and armored cavalry regiments. These GCS configurations will be HMMWV-mounted shelters with TCS Level Five capabilities, at two shelters per TUAV system. Additional HMMWV-mounted GCS configurations with TCS are required for divisions, corps, and echelons above corps to support the TUAV requirement at those

echelons. Specific GCS configurations will depend on the TUAV system supported. The TUAV system will have Remote Video Terminals (RVT) requiring TCS compatibility. Additionally, the USA requires TCS capabilities within other systems to include CGS, TES, and Guardrail Common Sensor/ACS IPF as well as TCS equipped workstations at the Army level.

   b. USMC. Requires TCS software for 11 (Level Five) VTUAV systems (2 GCSs per VTUAV system) to meet pre-positioning, war reserve, and expeditionary force requirements. VMU-1 will have 4 systems; VMU-2 will have 4 systems. There will be 3 VTUAV systems on maritime pre-positioned ships. Additionally, 3 TCS (Level Two) systems are required for JSIPS-TEG and 3 TCS (Level Two) systems for the JSTARS Common Ground Station.

   c. USN. Requires 159 ships to be outfitted with TCS control and dissemination software/equipment and 4 land-based GCSs equipped with TCS for VTUAVs (land-based system will be configured in HMMWVs) for UAV squadron training. Ship TCS distribution is: 11 systems for CV/CVN, 2 systems for LCC, 12 systems for LHA/LHD ships, 12 systems for LPD 17 class, 6 systems for METOC ships and 116 systems for DDGs and DD-21 surface combatants.

   d. USAF. Requires TCS software for the 12 Predator MAE UAV systems.

   e. Training. TCS software will be required to support joint training at locations to be determined.

7. Schedule Considerations

   a. TCS development schedule will, to the maximum extent possible, support service UAV development, testing, procurement, Initial Operation Capable (IOC) and Full Operation Capable (FOC) timelines. Agreements will be coordinated between the TCS and UAV System Program Offices to ensure the desired TCS product is delivered to support such events.

   b. IOC/FOC. For TCS capability not associated with a Service-specific UAV program, IOC and FOC will be defined by mutual consent between the TCS Program Office and the requesting platform sponsor.

   c. Impact if IOC/FOC Not Met. If IOC or FOC, as defined above, is not met, the delay would result in the TCS program to be mismatched with the TUAV and VTUAV fielding schedules. Failure to marry TCS and UAV fielding shcedules could lead to expensive retrofiting to integrate TCS capability, and ultimately delay delivery of a vital capabilty to the warfighter.

8. Program Affordability. The current TCS funding profile is as follows:

CATEGORY $$	Prior Years	FY99	FY00	FY01	FY02	FY03	FY04	FY05	Total	
RDT&E ($M)	79.4M	32.1M	27.5M	15.7M	9.5M	9.4M	9.6M	9.8M	193.0M	Threshold
RDT&E ($M)	79.4M	32.1M	30.5M	17.2M	10.5M	10.4M	10.6M	10.8M	201.5M	Objective

All threshold and objective values are specifically identified within the main body of the ORD. The table below summarizes only those values in the TCS ORD that apply specifically to the different *Service-specific Unmanned Aerial Vehicles*.

REQUIREMENT	AIR VEHICLE			
	TUAV	*VTUAV*	*PREDATOR*	*HAE*
The TCS software, operating within Army, U.S. Marine Corps and Navy GCS' will support Level Five interaction with their organic UAVs .	T	T	NA	NA
TCS will be incorporated into the USAF RQ-1 Predator MAE GCS to provide TCS direct data receipt.	NA	NA	T	NA
TCS will support interfaces with identified Command, Control, Communications, Computers, and Intelligence (C^{4}I) systems.	T	T	T	OBJ
TCS will be hosted on DII/COE compliant hardware.	T	T	NA	OBJ
TCS will support simultaneous flight and payload control of at least two AVs, line of sight.	T	T	NA	NA
TCS will provide sufficient cues to allow the UAV operator to safely takeoff, land and navigate under Instrument Flight Rules.	T	T	NA	NA
TCS will support an automatic launch and recovery system for those UAVs with the capability.	OBJ	T	NA	NA
TCS will support interfaces with the respective Service organic UAV data links as necessary to execute control of the AV and payload.	T	T	NA	NA
TCS will support interoperability up to Level Five with other Service Tactical UAVs (excluding Pioneer and Hunter).	OBJ	OBJ	NA	NA
TCS will support up to Level Four with USAF RQ-1 Predator MAE	OBJ	OBJ	NA	NA
TCS will support direct payload data receipt from High Altitude Endurance (HAE) UAVs	OBJ	OBJ	NA	NA
Support simultaneous flight and payload control of at least two AVs, beyond line of sight	OBJ	OBJ	NA	NA

T=Threshold   OBJ=Objective   NA=Not Applicable

Appendix A

All threshold and objective values are specifically identified withihn the body of the ORD. The terms "(Threshold)" and "(Objective)" immediately follow the stated requirement. Key performance parameters are identified by the term "(**KPP**)" in bold type immediately following the stated requirement. Additional information (sometimes stated in directive terms) is considered amplifying data. The following table summarizes the KPPs in the main body of this ORD:

KPP (THRESHOLD)	OBJECTIVE	PAGE/ PARAGRAPH
The TCS software, operating within USA, USMC and USN GCS's will support Level Five interaction with their organic UAVs. The USAF RQ-1 Predator GCS will incorporate TCS Level Two data/information interoperability with the Predator AV and provide data dissemination to the TCS required C4I nodes.	The TCS software will support, up to and including, Level Five interoperability with future TUAVs and, up to and including, Level Four with USAF RQ-1 Predator MAE and Level Two with the HAE.	Page 5 Paragraph 4.a.(1)
Support simultaneous flight and payload control of at least two AVs, line of sight (LOS), excluding legacy USAF Predator systems.	Support simultaneous flight and payload control of at least two AVs, beyond line of sight (BLOS).	Page 5 Paragraph 4.a.(1)(h)
TCS will be interoperable with different types of UAVs and UAV payloads across the five levels of interaction, excluding legacy USAF Predator systems.	**…**and at least two different platforms and payloads simultaneously.	Page 5 Paragraph 4.a.(1)(i)
TCS will be interoperable with the C^4I systems listed in paragraph 5e(2) of this ORD per ASD (C3I) JTA standards[4]. [4] Not all C4I systems are required at IOC. Joint Service priority will be promulgated by separate correspondence.	TCS will be interoperable with the additional C^4I systems listed in paragraph 5e(3) of this ORD.	Page 9 Paragraph 4.a.(6)(b)

Table A